

Amendments to the Claims:

This listing of claims will replace all prior versions,
and listings, of claims in the application:

Listing of Claims:

Claim 1 (canceled)

Claim 2 (currently amended): Positioning apparatus
comprising:

at least one position sensor,
at least one position controller and
at least one position actuator,
wherein the or each position sensor measures the
position of a position-controlled device,
wherein the or each position controller uses
measurement signals provided by the or each position
sensor as input signals,
wherein output signals generated by the or each
position controller are used by the or each position
actuator to control the position of said position-
controlled device,

the positioning apparatus further comprising a gravity compensation device compensating gravitational forces acting on said position-controlled device, wherein the gravity compensation device includes at least one gravity compensation controller and at least one gravity compensation actuator, wherein the or each gravity compensation controller uses the output signals generated by the or each position controller as input signals, thereby generating output signals used by the or each gravity compensation actuator to compensate gravitational forces acting on said position-controlled device, according to claim 1,

~~characterized in that~~wherein the gravity compensation actuator ~~(17)~~ comprises a spring ~~(18)~~, a string ~~(19)~~, a pulley ~~(20)~~ and a motor ~~(21)~~.

Claim 3 (currently amended): Positioning apparatus according to claim 2, ~~characterized in that~~wherein the spring ~~(18)~~ is attached with a first end preferably to the position-controlled device ~~(11)~~ and with a second end to the string ~~(19)~~.

Claim 4 (currently amended): Positioning apparatus according to claim 2, ~~characterized in that~~wherein the string-(19) is wound around the pulley-(20), wherein the pulley-(20) is driven by the motor-(21), and wherein the motor-(21) is controlled by the output signals generated by the gravity compensation controller-(25, 28).

Claim 5 (currently amended): Positioning apparatus according to claim 2, ~~characterized in that~~wherein the pulley-(20) is driven by the motor-(21) in a way that the tension in the spring (18) is kept constant and equal to the gravitational forces acting on said position-controlled device-(11).

Claim 6 (canceled)

Claim 7 (canceled)

Claim 8 (currently amended): Positioning apparatus comprising:

at least one position sensor,

at least one position controller and

at least one position actuator,

wherein the or each position sensor measures the
position of a position-controlled device,

wherein the or each position controller uses
measurement signals provided by the or each position
sensor as input signals,

wherein output signals generated by the or each
position controller are used by the or each position
actuator to control the position of said position-
controlled device,

the positioning apparatus further comprising a
gravity compensation device compensating gravitational
forces acting on said position-controlled device, wherein
the gravity compensation device includes at least one
gravity compensation controller and at least one gravity
compensation actuator, wherein the or each gravity
compensation controller uses the output signals generated
by the or each position controller as input signals,
thereby generating output signals used by the or each
gravity compensation actuator to compensate gravitational
forces acting on said position-controlled device,

the gravity compensation device further including two gravity compensation controllers, wherein a first gravity compensation controller of the two gravity compensation controllers uses the output signals generated by the position controller as input signals, wherein a second gravity compensation controller of the two gravity compensation controllers uses the output signals generated by the first gravity compensation controller as input signals, and wherein output signals from said second gravity compensation controller are used to control the gravity compensation actuator,

~~according to claim 7, characterized in that~~wherein
the output signals generated by the first gravity compensation controller~~-(25)-~~ are summed with a position setpoint signal of said position controller~~-(13)-~~, wherein the resulting signal is used as setpoint for said second gravity compensation controller~~-(28)-~~.

Claim 9 (currently amended): Positioning apparatus
comprising:

at least one position sensor,
at least one position controller and

at least one position actuator,
wherein the or each position sensor measures the
position of a position-controlled device,
wherein the or each position controller uses
measurement signals provided by the or each position
sensor as input signals,
wherein output signals generated by the or each
position controller are used by the or each position
actuator to control the position of said position-
controlled device,
the positioning apparatus further comprising a
gravity compensation device compensating gravitational
forces acting on said position-controlled device, wherein
the gravity compensation device includes at least one
gravity compensation controller and at least one gravity
compensation actuator, wherein the or each gravity
compensation controller uses the output signals generated
by the or each position controller as input signals,
thereby generating output signals used by the or each
gravity compensation actuator to compensate gravitational
forces acting on said position-controlled device,

the gravity compensation device further including two gravity compensation controllers, wherein a first gravity compensation controller of the two gravity compensation controllers uses the output signals generated by the position controller as input signals, wherein a second gravity compensation controller of the two gravity compensation controllers uses the output signals generated by the first gravity compensation controller as input signals, and wherein output signals from said second gravity compensation controller are used to control the gravity compensation actuator,

~~according to claim 7, characterized in that~~wherein
the second gravity compensation controller~~-(28)~~ uses the measurement signal of a motor position sensor~~-(29)~~ as input signal, wherein said motor position sensor measures the position of the motor~~-(21)~~ of said gravity compensation actuator ~~-(17)~~.

Claim 10 (canceled)

Claim 11 (currently amended): Gravity compensation device
for compensating gravitational forces acting on a

position-controlled device, wherein the position of said
position-controlled device is measured by at least one
position sensor and controlled by at least one position
controller, the device having at least one gravity
compensation controller and at least one gravity
compensation actuator, wherein the or each gravity
compensation controller uses the output signals generated
by the or each position controller as input signals,
thereby generating output signals used by the or each
gravity compensation actuator to compensate gravitational
forces acting on said position-controlled device~~according~~
~~to claim 10, characterized in that~~wherein the gravity
compensation actuator ~~(17)~~ comprises a spring ~~(18)~~, a
string ~~(19)~~, a pulley ~~(20)~~ and a motor ~~(21)~~.

Claim 12 (currently amended): Gravity compensation device
according to claim 11, ~~characterized in that~~wherein the
spring ~~(18)~~ is attached with a first end preferably to the
position-controlled device ~~(11)~~ and with a second end to
the string ~~(19)~~.

Claim 13 (currently amended): Gravity compensation device according to claim 11, ~~characterized in that~~wherein the string~~-(19)~~ is wound around the pulley~~-(20)~~, whereby the pulley~~-(20)~~ is driven by the motor~~-(21)~~, and whereby the motor~~-(21)~~ is controlled by the output signals generated by the gravity compensation controller~~-(16; 28)~~.

Claim 14 (currently amended): Gravity compensation device according to claim 11, ~~characterized in that~~wherein the pulley~~-(20)~~ is driven by the motor~~-(21)~~ in a way that the tension in the spring is kept constant and equal to the gravitational forces acting on said position-controlled device~~-(11)~~.

Claim 15 (canceled)

Claim 16 (canceled)

Claim 17 (currently amended): Gravity compensation device for compensating gravitational forces acting on a position-controlled device, wherein the position of said position-controlled device is measured by at least one

position sensor and controlled by at least one position
controller, the gravity compensation device comprising at
least one first gravity compensation controller and at
least one gravity compensation actuator, wherein the at
least one first gravity compensation controller uses the
output signals generated by the at least one position
controller as input signals, thereby generating output
signals used by the at least one gravity compensation
actuator to compensate gravitational forces acting on said
position-controlled device, the device further comprising
a second gravity compensation controller, wherein the at
least one first gravity compensation controller uses the
output signals generated by the position controller as
input signals, wherein the second gravity compensation
controller uses the output signals generated by the at
least one first gravity compensation controller as input
signals, and wherein output signals from said second
gravity compensation controller are used to control the
gravity compensation actuator~~according to claim 16,~~
~~characterized in that~~wherein the output signals generated
by the first gravity compensation controller ~~(25)~~ are
summed with a position setpoint signal of said position

controller~~-(13)~~, whereby the resulting signal is used as setpoint for said second gravity compensation controller ~~-(28)~~.

Claim 18 (currently amended): Gravity compensation device for compensating gravitational forces acting on a position-controlled device, wherein the position of said position-controlled device is measured by at least one position sensor and controlled by at least one position controller, the gravity compensation device comprising at least one first gravity compensation controller and at least one gravity compensation actuator, wherein the at least one first gravity compensation controller uses the output signals generated by the at least one position controller as input signals, thereby generating output signals used by the at least one gravity compensation actuator to compensate gravitational forces acting on said position-controlled device, the gravity compensation device further comprising a second gravity compensation controller, wherein the at least one first gravity compensation controller uses the output signals generated by the position controller as input signals, wherein the

second gravity compensation controller uses the output
signals generated by the at least one first gravity
compensation controller as input signals, and wherein
output signals from said second gravity compensation
controller are used to control the gravity compensation
actuator, according to claim 16, characterized in
that wherein the second gravity compensation controller
(28) uses the measurement signal of a motor position
sensor (29) as input signal, whereby said motor position
sensor measures the position of the motor (21) of said
gravity compensation actuator (17).

Claim 19 (canceled)

Claim 20 (currently amended): Method for compensating
gravitational forces acting on a position-controlled
device, whereby the position of said position-controlled
device is measured by at least one position sensor and
controlled by at least one position controller, wherein at
least one gravity compensation controller uses output
signals generated by the or each position controller as
input signals thereby generating output signals used by at

least one gravity compensation actuator to compensate
gravitational forces acting on said position-controlled
device~~according to claim 19, characterized in that~~wherein
the gravity compensation actuator comprises a spring, a
string, a pulley and a motor, whereby the spring is
attached with a first end to the position-controlled
device and with a second end to a the string, wherein the
string is wound around the pulley, and wherein the pulley
is driven by the motor using the output signals generated
by the gravity compensation controller in a way that the
tension in the spring is kept constant and equal to the
gravitational forces acting on said position-controlled
device.

Claim 21 (canceled)

Claim 22 (canceled)

Claim 23 (currently amended): Method for compensating
gravitational forces acting on a position-controlled
device, whereby the position of said position-controlled
device is measured by at least one position sensor and

controlled by at least one position controller, whereby at
least one gravity compensation controller uses output
signals generated by the or each position controller as
input signals thereby generating output signals used by at
least one gravity compensation actuator to compensate
gravitational forces acting on said position-controlled
device~~according to claim 22,~~
wherein two gravity compensation controllers are used, a
first gravity compensation controller using the output
signals generated by the position controller as input
signals and a second gravity compensation controller using
the output signals generated by the first gravity
compensation controller as input signals, output signals
of said second gravity compensation controller being used
to control the gravity compensation actuator,
~~characterized in that~~ output signals generated by the
first gravity compensation controller ~~being~~ are summed with
a position setpoint signal of said position controller,
whereby the resulting signal is used as setpoint for said
second gravity compensation controller, and the second
gravity compensation controller uses the measurement
signal of a motor position sensor as input signal, whereby

said motor position sensor measures the position of the motor of said gravity compensation actuator.

Claim 24 (new): A positioning apparatus comprising:

at least one position sensor, at least one position controller, at least one position actuator and at least one gravity compensation device,

the gravity compensation device comprising at least one gravity compensation controller and at least one gravity compensation actuator and being capable of compensating gravitational forces acting on a position-controlled device,

wherein the position sensor is configured to measure a position of the position-controlled device,

the position controller is capable of using measurement signals provided by the position sensor as input signals to generate output signals, and

the output signals generated by the position controller are manipulated variable output signals used by the position actuator to control the position of the position-controlled device and further serve as signals

inputting a controlled variable to the at least one
gravity compensation controller,

thereby generating output signals used by the gravity
compensation actuator to compensate gravitational forces
acting on the position-controlled device.

Claim 25 (new): The positioning apparatus of claim 24,
wherein the gravity compensation device further includes a
second gravity compensation controller, wherein the
gravity compensation controller uses the output signals
generated by the position controller as input signals of a
controlled variable, and wherein the second gravity
compensation controller uses the output signals generated
by the first gravity compensation controller as input
signals, and wherein output signals from said second
gravity compensation controller are used to control the
gravity compensation actuator.

Claim 26 (new): A gravity compensation device for
compensating gravitational forces acting on a position-
controlled device, wherein the position of the position-
controlled device is measured by at least one position

sensor and controlled by at least one position controller, the gravity compensation device comprising at least one gravity compensation controller and at least one gravity compensation actuator, wherein the gravity compensation controller uses output signals of a manipulated variable generated by the position controller as input signals of a controlled variable, thereby generating output signals used by the or each gravity compensation actuator to compensate gravitational forces acting on the position-controlled device.

Claim 27 (new): The gravity compensation device of claim 26, comprising a second gravity compensation controller, wherein the gravity compensation controller uses the output signals generated by the position controller as input signals of a controlled variable, wherein the second gravity compensation controller uses the output signals generated by the first gravity compensation controller as input signals, and wherein second gravity compensation controller output signals from the second gravity compensation controller are used to control the gravity compensation actuator.

Claim 28 (new): A method for compensating
gravitational forces acting on a position-controlled
device, the method comprising:

measuring a position of the position-controlled
device using a position sensor,

controlling the position-controlled device using a
position controller to generate output signals of a
manipulated variable from the measured position,

using the output signals generated by the position
controller as a controlled variable to generate output
signals of a gravity compensation controller,

using the output signals of the gravity compensation
controller to control a gravity compensation actuator and
compensate gravitational forces acting on the position-
controlled device thereby.

Claim 29 (new): The method of claim 28 wherein the step
of using the output signals of the gravity compensation
controller to control a gravity compensation actuator
comprises sending the output signals of the gravity

compensation controller directly to the gravity
compensation actuator.

Claim 30 (new): The method of claim 28 wherein the step
of using the output signals of the gravity compensation
controller to control a gravity compensation actuator
comprises sending the output signals of the gravity
compensation controller to a second gravity compensation
controller.